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AN AIR FORCE COMMAND AND CONTROL BATTLE LAB...

KEY TO INFORMATION AND BATTLEFIELD SUPERIORITY

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To ensure information superiority for warfighters in the 21st century, the Air Force needs to develop and implement a command and control battle lab. This facility must rapidly integrate new command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) technologies, doctrine, and concepts of operations into the joint warfighting arsenal. Air Force leadership has taken a critical first step by defining information superiority as a core competency. The next phase is to determine a strategy for its execution. Our current acquisition system is woefully lacking in its ability to obtain technology. Equally lacking is the warfighter?s ability to modify doctrine and organizations to best exploit the technology. A promising solution is the battlefield laboratory, or battle lab. The philosophy of a battle lab is to create a place where warfighters, developers, and industry come together to evaluate, integrate, and apply technology. There are ongoing attempts to create this synergistic trinity, but the optimal combination has not been achieved. This paper will identify the critical elements of a battle lab, propose a prototype structure, and address major obstacles to its success. Because little has been written on battle lab operations, much of the research material was derived from interviews with visionary military and civilian leaders, and with personnel involved in ongoing battle lab projects. Literature was reviewed from sources such as the Air Force Scientific Advisory Board and the Advanced Battlespace Information Task Force.

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Preface

> *Man’s mind, once stretched by a new idea, never regains its original dimensions.*
>
> —Oliver Wendell Holmes

On 2 July 1994, Lt Gen Charles E. Franklin, Commander of Electronic Systems Center (ESC) decided it was time to demonstrate the pervasive power of command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) to decision makers, warriors, developers and industry. His only direction to his team was, “be innovative.” The problem was no one at ESC, or within the Air Force for that matter, had ever seen the latest C4ISR systems and prototypes operating together. Fortunately, there were some bright minds at ESC and MITRE (a federally funded research and development center), in industry, and in the warfighting community. They had been waiting for the opportunity to lash it all together and see what it could do. While far from bringing the entire spectrum of C4ISR technology together, they did make enormous strides in realizing their goal.

By leveraging the assets and talents of the varied organizations, the five temporary battle labs (nicknamed Fort Franklin) and the permanent Command and Control Unified Battlespace Environment (CUBE) began to reshape the way we harness technology and ideas, and create C4ISR capability. They have also given new insights into conquering the elusive goal of information superiority.

The philosophy of the battle lab is simple—provide a place where warfighters, developers, and industry can work together. Air Force leadership quickly grasped the value of this team and set out to create six labs. The challenge facing them is how to make it work.

The purpose of this paper is to offer suggestions for developing and implementing the battle labs. It will synthesize the thoughts of visionary leadership and literature to determine the essential elements for success. Failure to address each of these elements will doom the battle lab to becoming another stovepiped process, prime for the chopping block.

The battle lab concept has been successful because of its ability to facilitate cooperation and minimize parochial interests. Hopefully, planners and leaders will use this same philosophy in the creation of the Air Force Battle Lab.

Abstract

To ensure information superiority for warfighters in the 21st century, the Air Force needs to develop and implement a command and control battle lab. This facility must rapidly integrate new command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) technologies, doctrine, and concepts of operations into the joint warfighting arsenal. Air Force leadership has taken a critical first step by defining information superiority as a core competency. The next phase is to determine a strategy for its execution. Our current acquisition system is woefully lacking in its ability to obtain technology. Equally lacking is the warfighter's ability to modify doctrine and organizations to best exploit the technology. A promising solution is the battlefield laboratory, or battle lab. The philosophy of a battle lab is to create a place where warfighters, developers, and industry come together to evaluate, integrate, and apply technology. There are ongoing attempts to create this synergistic trinity, but the optimal combination has not been achieved. This paper will identify the critical elements of a battle lab, propose a prototype structure, and address major obstacles to its success. Because little has been written on battle lab operations, much of the research material was derived from interviews with visionary military and civilian leaders, and with personnel involved in ongoing battle lab projects. Literature was reviewed from sources such as the Air Force Scientific Advisory Board and the Advanced Battlespace Information Task Force.

Chapter 1

Information Superiority

Information will become a prominent, if not predominant, part of war to the extent that whole wars may well revolve around seizing or manipulation of the enemy's datasphere.

—Colonel (Ret) John Warden

Introduction

Problem Definition

Titanic forces beyond its control are shaking the Department of Defense to its very core. Geopolitical unrest, falling domestic support, mission creep, and rapid commercial technological innovation are severely challenging the ability of military planners, developers, and warriors to adapt. Equally frustrating to the military command structure is the fourth dimension, cyberspace, which is redefining force structure and operations. How do future warriors gain and sustain information superiority? How do they rapidly obtain and fuse changes in technology with innovative doctrine and tactics? Battle labs may offer the solution.

Since the concept of battle labs is evolving, and current facilities exist in a number of configurations, the definition of "battle lab" is not a simple one. In general, it is a place where personnel can experiment with new technology, doctrine, tactics, techniques, and procedures. It is rapidly adaptable, open to innovation, and facilitates cooperation and synergy among experimenters. The product is new military capability for the warfighter. For the purposes of this paper, command and control is the ability to observe, plan, and direct operations. It is enabled by command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) technology, concepts of operations, and organizations.

The Air Force has taken a bold step in approving the creation of six battle lab facilities. The challenge is implementing them effectively. This paper will describe factors which have led to the need for battle labs and how they will be used. From interviews with visionaries and reviews of recent literature, it will identify the critical elements for the formation and operations of a battle lab and conclude with a recommended course of action.

Interviews

The following visionaries from the warfighter, developer, and industry communities were interviewed for their insights into battle lab creation:

1. Lieutenant General (Ret) Charles E. Franklin, Vice President, Program and Mission Success, Sanders Corp., former Commander, Electronic Systems Center (ESC)
2. Mr. John M. Gilligan, Program Executive Officer, Battle Management
3. Mr. James W. Henderson, President, Analytical Systems Engineering Corporation
4. The Honorable Arthur L. Money, Assistant Secretary of the Air Force (Acquisition)
5. Brigadier General David A. Nagy, Mission Area Director, Information Dominance
6. Mr. Robert Nesbit, Vice President Center for Integrated Intelligence Systems, MITRE Corporation, member of the Defense Science Board
7. Admiral (Ret) William A. Owens, President and Chief Operations Officer and Vice Chairman of the Board, Science Applications International Corp. (SAIC), former Vice Chairman, Joint Chiefs of Staff
8. Brigadier General (Sel) Wilbert D. Pearson, Vice Commander, ESC
9. Lieutenant General Joseph J. Redden, Commander, Air University
10. Major General (Ret) Robert A. Rosenberg, Executive Vice President, SAIC, former member of the Air Force Scientific Advisory Board

Today's Environment

Joint Vision 2010

Joint Vision 2010 is a landmark document setting the stage for future joint operations. While information has always been indispensable to the warrior, *Joint Vision 2010* has placed it in a preeminent position on which all operations must depend. The new concept of operations is defined by dominant maneuver, precision engagement, focused logistics, and full dimensional protection. All four concepts rely upon the ability to collect, process, disseminate, deny, and exploit information while operating without interruption…information superiority. Information superiority will enable enhanced command and control (C2), fused intelligence, dominant awareness, and offensive and defensive information warfare.[1] *Joint Vision 2010* is a rallying point behind which the services can build cooperation and unify operations.

Global Engagement

In response to *Joint Vision 2010*, the Army has released *Army Vision 2010*; the Navy, *Forward from the Sea*; the Marines, *Sea Dragon*; and the Air Force, *Global Engagement*. *Global Engagement* is a revolutionary counterpart to *Joint Vision 2010*. It is thrusting the Air Force away from its platform/specialist mentality and into the realm of heightened cooperation, new technology, and innovative concepts of operations (CONOPS). Secretary of the Air Force Dr. Sheila Widnall and Air Force chief of staff Gen Ronald Fogleman have defined the Air Force's core competencies as air and space superiority, global attack, rapid mobility, precision engagement, information superiority, and agile combat support. The key elements to this "alternative to classic warfare" are acquisition reform, exploitation of information technology, and modeling and simulation. Finally, *Global Engagement* reiterated the warfighter's dependence on information superiority.[2]

Vulnerabilities

While future warfare is dependent on information superiority, such superiority may be much more elusive than any of the other core competencies. A recent RAND study pointed to several pitfalls in the quest. Of note, engaging too early in the information revolution may make a country vulnerable to previous forms of warfare. Additionally, the definition of information superiority will vary dramatically by the type of conflict. Info-war attacks may be difficult against a third world opponent who depends little on information technologies.[3]

The *Advanced Battlespace Information System (ABIS)* Task Force Report emphasized that industry, not the DOD, is now the driving force behind information technology. Because it is commercially built and sold on the open market, the technology is more freely available to our adversaries. Furthermore, these adversaries are improving their technical capabilities, thereby forcing the US to assimilate technology faster to stay ahead. This assimilation involves not only buying high tech systems but also restructuring and implementing new organizations, CONOPS and tactics, techniques, and procedures (TTP) to optimize their performance.[4] An often cited example of this revolution in military affairs (RMA) is the German modification of organizations and tactics of tank and aircraft warfare to create the Blitzkrieg.[5] Mr. Nesbit stated, "Information warfare is not a function of technology, it is totally people centric. How fast and well the people learn, adapt, and invent will dictate how successful they are."[6] This is exacerbated in coalition environments where equipment and missions vary dramatically. The adaptability and flexibility of people and systems will be critical to proficient and effectual operations.

In summary, information and information technologies have become the quintessential element on the battlefield. The ability of a military to take advantage of commercial off-the-shelf (COTS) technology, and to change organizations, doctrine, and TTP will define its success on future battlefields. The key to any solution is breaking down the barriers to change and creating a synergistic environment for participants. A command and control battle lab brings together warfighters, developers, and industry to assess, acquire, experiment, test, and integrate new information capability into the warfighting arsenal rapidly!

Notes

[1] *Joint Vision 2010*, 1996, 11,12,15.

[2] *Global Engagement: A Vision for the 21st Century Air Force*, 1996, 1,3,17,23.

[3]RAND Issue Paper, Information War and the Air Force: *Wave of the Future? Current Fad?*, Mar 1996, 3,11.

[4]Joint Chiefs of Staff, Director of Command, Control, Communications, and Computers/Director, Defense Research and Engineering.. *Advanced Battlespace Information System* Task Force Report, Executive Summary, Volume I: May 96, ES-5.

[5]FitzSimonds and van Tol, “Revolutions in Military Affairs,” *Joint Force Quarterly*, Spring 1994, 2.

[6]Mr. Robert Nesbit, MITRE Corp., interviewed by author, 25 Nov 96.

Chapter 2

Battle Labs

We must get technology to the warfighters in the same generation that it is conceptualized.

—The Honorable Arthur L. Money

Visionaries

Leadership

For simplicity, participants in the battle lab process fall into three groups: Warfighters, developers, and industry. Warfighters create requirements, fund programs, advocate development, and operate the systems. They are responsible for maintenance, operational testing, and the development of doctrine, TTP, and training. Developers conduct research and development, complete source selections and contract award, monitor contract compliance, and deliver the systems. They create the overall logistics plan, conduct developmental testing, and are responsible for technical integration, interoperability, and architecture and standard compliance. Industry has two branches to its operations. In the first, it takes military requirements and creates the most effective system possible while earning a profit for their investors. In the second, it develops new systems to satisfy commercial and government needs without specific direction from either.

Following are the thoughts of leaders from the three communities. While each brings a different perspective to the challenge of fielding capability, they are united in their belief that a battle lab may offer the solution. From the warfighter viewpoint, Gen Redden describes the need for a unifying effort to tie together the joint battlefield. There should be an ability to evaluate new concepts or technology, conduct tradeoffs, and understand the impacts to doctrine, TTP, and current capabilities. He believes a distributed battle lab would enable this unification.[1] According to Gen Franklin, a developer, the battle lab is where warfighters, developers, and industry break down the incompatibility of technology and acquisition timelines.[2] Speaking from an industry perspective, Mr. Henderson observes, “The battle lab is an excellent vehicle to educate people outside the DOD, such as in the political and civic communities. Prior to Fort Franklin (battle lab) there was no way to lash things together and show people the full spectrum and importance of C2. It allows systems to be wrung out before fielding and provides a more cost effective method to develop, test, and train. By combining the R&D (Research and Development) and warfighting communities, it assures systems produced are in concert with warfighter needs.”[3]

Literature

There have also been a number of studies that echo the remarks of the visionary leaders. The Air Force Scientific Advisory Board (SAB) *Vision of Aerospace Command and Control For the 21st Century* characterized the need for a development engine that would provide a platform to assess and workout operational problems, develop concepts of operations and doctrine, and assess new threats. Likewise, the development engine would become the core of acquisition reform by providing an engineering and integration support facility, a platform for modeling the joint environment, a means of completing test and evaluation throughout development, a place to perform value determination assessments and source selections, and a means to participate in exercises.[4]

Air Force Battle Labs

While there have been several attempts to develop an Air Force battle lab, the latest emphasis was initiated by an admiral. In April 1995, ADM William Owens, vice chairman of the Joint Chiefs of Staff, visited the Fort Franklin battle lab encampment at Hanscom AFB, MA. Liking what he saw, he directed that at the next encampment in September 1995, the Army and Air Force bring together their theater missile defense cells for interoperability testing. In September, ADM Owens brought the Joint Requirements Oversight Council (JROC) to observe the results. Gen Thomas Moorman, Air Force vice chief of staff, was one of the JROC members. He quickly grasped the potential of a battle lab and upon his return directed the initiation of an implementation study. At three consecutive meetings of CORONA, Air Force four-star generals reviewed concepts and information concerning battle lab creation and operations. At the 1996 Spring CORONA, a plan for five battle labs was approved, with a sixth joining the list weeks after the meeting. They are to be located at Air Force centers of excellence with their missions or emphasis as follows: Information Warfare, Battlefield Management/Command and Control, Air Expeditionary Force, Unmanned Aerial Vehicle, Space Warfare, and Force Projection. Their purpose, as defined in *Global Engagement,* is to experiment, test, exercise, and evaluate CONOPS and explore ideas and foster innovative technology.[5]

Planning for the labs is well underway, with initial operating dates for three of the labs of 1 April 1997.

Leaders have agreed that the battle lab concept offers a great opportunity for integrating technology with operations. Past and ongoing efforts are making strides toward achieving that goal. The challenge is to learn from these efforts, integrate their capabilities, and leverage available people and facilities to best operate the AFBLs. A number of options for the labs have been proposed, such as lab nodes in industry and product centers; or at operational wings and exercises; or in laboratories and universities; or entirely distributed. The solution can only be determined by identifying the vital elements of a potent battle lab.

Notes

[1]Lt Gen Joseph J. Redden, Air University, Maxwell AFB, AL, interviewed by author, 26 Nov 96.

[2]Lt Gen (Ret) Charles E. Franklin, Sanders Co., interviewed by author, 15 Nov 96.

[3]Mr. James W. Henderson, ASEC, interviewed by author, 8 Nov 96.

[4]Air Force Scientific Advisory Board, *C4I Vision of Aerospace Command and Control For the 21st Century* 96, Summer 1996, 9-12.

[5]Air Force, *Global Engagement: A Vision for the 21st Century Air Force*, 1996, 9.

Chapter 3

A Case Study

This is an unprecedented capability the DOD needs on a permanent basis.

—Admiral William Owens (to the JROC while attending Fort Franklin IV)

The best place to start in identifying critical elements is to examine past efforts. Perhaps the most successful large scale operation is the Fort Franklin series, and its permanent counterpart, the Command and Control Unified Battlespace Environment (CUBE). Though far from perfect, they offer a framework to build upon.

Fort Franklin

Background

The First Fort Franklin (FFI) started as a place to demonstrate the value and power of C4ISR. It grew from 20 autonomous systems to hundreds of interoperable systems with worldwide connectivity. The fifth fort (FFV) successfully concluded operations in August 1997. In all, the Fort series has accomplished over 300 first-ever experiments and educated over 10,000 visitors. The question is why has it flourished?

The Fort/CUBE strength lies in people and hardware. Electronic Systems Center (ESC) is the C4I center of excellence for the Air Force. With over 10,000 employees and a budget just under four billion dollars, ESC has considerable leverage in combining the latest concepts and technologies into a realistic configuration. For example, in FFIV, an AOC, Wing Operations Center (WOC), information warfare cell, and Army and Air Force theater missile defense cells were brought together to conduct experimentation. At sea, the USS LaSalle (in the Mediterranean), the USS America (in the Atlantic), and the USS Kittyhawk (in the Pacific) participated. Each of the facilities at FFIV could not talk directly to one another, but instead went through a minimum of two tactical microwave links. The AOC and WOC communicated through the reachback facility in Hawaii. Though many of the more than 160 systems brought in from labs, industry, and the field were not designed to be interoperable, innovative systems engineering resulted in successful operations. For the first time, Air Tasking Order (ATO) databases were transferred electronically to and from ships at sea. Army and Air Force theater missile defense cells integrated operations and leveraged off each other's strengths. Finally, a system originally designed to support farmers planting crops was modified to alert troops of an impending missile attack within two minutes of detection.

One of the FFV experiments was a new facility called Forward Falcon. At Aviano AB, Italy, a crack team of junior officers had created an integrated operations/intelligence cell. Their next challenge was to make it mobile. Working with ESC technical experts, a preliminary design was created. While the Aviano staff worked the operational requirements, the CUBE/Fort/industry team created the technical solution. Four months later the first prototype was successfully unveiled at FFV. By working closely together, warfighters, developers, and industry were able to come up with not only new technology, but new ways of using it in the field. They did it rapidly, effectively, and at minimal cost.

The CUBE

The CUBE builds on the Fort Franklin experience by creating a permanent setting. Its primary roles are research and technical assessments, integration and interoperability testing, and contingency and exercise support. Its first project came as a result of a meeting with Lt Gen Franklin, ESC commander, and Maj Gen Hornberg, director of the Combined AOC (CAOC) in Vicenza, Italy. Gen Hornberg and his ingenious staff had brought the latest systems from around the globe to give the CAOC unparalleled capability. Unfortunately, because there was no overarching architecture or standards between the systems, and few technical experts, interoperability, configuration control, and supportability were difficult. Additionally, capabilities such as the Joint STARS ground picture were not obtainable.

The CUBE was set up in a former Army Reserve drill hall and functionally configured to represent the CAOC. Although many of the joint and coalition systems were unavailable, enough functionality was achieved to address the major issues. Adding to ESC and MITRE expertise, Air National Guard, Air Force Reserve, and contractor help was enlisted. With a prioritized list of 28 deficiencies, the CUBE group sent a number of teams to Italy to install fixes and document the current configuration. Over the succeeding months the list of 28 were either closed or integrated into ongoing programs. CAOC personnel were so pleased they offered the CUBE office space for a full time liaison. After studying the CAOC and CUBE, Gen Rosenberg recommended to the Secretary of Defense that, "the CUBE efforts should be used as a model for the future."[1]

Besides contingency operations, the CUBE is engaged in conducting a number of experiments to include common operational picture tradeoffs, evaluations of information warfare protection guards, and global broadcasting options. The results are directly benefiting program development and operational capability. To facilitate cooperation with industry, they have radically altered Cooperative Research and Development Agreements (CRDAs). These no-cost agreements, which in the past typically took from six to twelve months to complete, are now routinely established in under a week.

Encouraged by their success, ESC has traded with the Army Reserve to obtain the CUBE building permanently and is integrating its more than 100 R&D laboratories into the building. The facility will be configured to allow for full scale integration testing while retaining separate labs for individual systems work. Funding of the five Forts and the CUBE has largely come from directing program office assets towards innovative technology and application improvements. Expenses for permanent staff and non-program specific experiments are derived from ESC overhead and warfighter contributions. Industry, seeing the benefit of being more closely involved with military development and operations, is participating at its own expense. Realizing the benefits of cooperation, CUBE and Reserve personnel have also established 20 reserve positions, with an additional 20 positions in work.

While the cost of the facilities to the taxpayer is negligible, formal funding is mandatory for continuity of the staff and to conduct extensive advanced projects. As Mr. Gilligan stated, "They (battle labs) are not cheap to operate; we don't want them to drain money away from formal acquisition. There are other places to obtain money from the outside. For instance, the "Joint Forces Air Component Commander (JFACC) After Next" initiative has more money than the entire Theater Battle Management Core Systems (TBMCS) program."[2]

Joint Vision 2010 and *Global Engagement* highlight the importance of people. Setting up facilities is relatively simple, but obtaining expertise is not. The Hanscom team succeeds when they stay within the realm of C4ISR R&D. They are less successful as they approach full scale operations because they lack the expertise. Although warfighters are available in limited experiments, there is no continual presence, either locally or remotely. Additionally, technologies at a product center are generally hardware and software prototypes with limited availability. This bare bones approach works well for rapid adaptation and change but is lacking for full scale integration into operations. A follow-on facility is required to transition mature technologies and ideas into full scale operations. Lastly, ESC's expertise lies in C4ISR technology. Since this is only one component of the warfighting arsenal, additional facilities and expertise are required for other mission areas.

Notes

[1]Maj Gen (Ret) Robert A. Rosenberg, SAIC, interviewed by author, 10 Dec 96.

[2]Mr. John M. Gilligan, Program Executive Officer for Battle Management, Pentagon, Wash DC, interviewed by author, 13 Dec 96.

Chapter 4

Creating A Battle Lab

The Battle Lab is a place where operational and development communities come together and leverage off each other's strengths.

—Mr. Gilligan

Thus far this study has expressed the need for battle labs, discussed their uses, and presented a successful case study. This chapter will coalesce the previous discussion to outline the critical elements essential to building a successful battle lab. It will not attempt to draw conclusions but will instead present possible alternatives. The chapter will close with several challenges to overcome in implementing the battle lab effectively. The critical elements for a battle lab are manning, location, operations, and process.

Critical Elements

Manning

The battle labs will be a failure if they don't include all the players. Operators, technologists, acquisition, and industry must get in same sand box and overcome the acquisition process by working together.

—Gen Rosenberg

Manning is not necessarily who should be residing in the facility, but who should be active participants and owners of the battle lab. The *ABIS* task force stated, "Together operational and technical communities are capable of making better judgments than either is alone." Continual interaction creates a smoother transition from concept to implementation, support, and training. It coordinates planning, architecture, integration, and evaluation. Operators focus on CONOPS and training, while R&D looks to enabling technologies and acquisition reform.[1]

Not only is it critical to team acquisition and operator personnel, but doctrine and industry representation is equally vital. Gen Redden described the critical need for a partnership with acquisition and for doctrine personnel to lead the organization.[2] Gen Franklin added that industry is spending millions on marketing that could be better spent working in a battle lab.[3] Discussing his recent experiences in industry, Admiral Owens concluded, "The battle lab needs to get the civilian contractors involved as quickly as possible. There's a lot going on out in the civilian world we don't know about. People in the Pentagon say places like DARPA and laboratories do know, but from my experience, I don't believe it."[4]

Location

> *The lab must be distributed. It will become totally irrelevant if it is self-contained.*
>
> —Gen Rosenberg

Location could be a facility, a network of facilities, or a moving target that moves as the concept of technology matures. Generally, the experts agreed the AFBL must leverage the strengths of each organization in a distributed configuration. Gen Redden insisted keeping the labs separate would stovepipe the people and their specialties and would inhibit the creation of comprehensive battlefield models.[5] Gen Nagy echoed these sentiments, stating that four labs directly affect and use information. Integration is essential to prevent stovepiping and achieve the big picture of operations.[6] Mr. Nesbit added a unique perspective, "The notion of a permanent battle lab turns down the activity level. You really need an exercise like Fort Franklin to keep things moving. Making it permanent somehow destroys the operations tempo. It has to replicate the ad hoc nature of quickly putting C3I together in real joint task force situations."[7]

Operations

Rank is inversely proportional to innovation.

—ADM Owens and Lt Gen Franklin

Operations is broken into mission, organization, and infrastructure. The operations of a particular node would be dictated by the location's expertise, personnel, and systems. While most of the interviews and documentation did not get into specifics, they did provide valuable insights on the focus of individual nodes, topcover, and to whom the AFBLs should report.

Mission. The mission of the overall battle lab has been described at length. The mission of the individual nodes would be highly dependent on their area of expertise. Gen Pearson stated it clearly, "Battle labs will fail if they focus too broadly or on other missions. For example, if Rome (laboratory) is focusing on operations and Hurlburt (Blue Flag) is focusing on research…then the labs would fail."[8] Gen Rosenberg added, "New technology should be introduced and executed at the CUBE while simultaneously Hurlburt should be seeing it on their screens and looking at the CONOPS. Virtual exercises should be conducted by tying together the joint services in major theaters. If they like what they see, then implement it…like JBS (Joint Broadcast Service) in Bosnia.

Metrics are also mandatory to report success in terms of objectives, goals, timelines, and accomplishments."[9]

Organization. In this area, the interviewees were concerned with insuring the right information made it to the right levels and freedom to experiment prevailed. Gen Franklin, Gen Rosenberg, and ADM Owens all agreed that four-star visibility was required. Gen Franklin believes the battle lab should report directly to the VCJCS and be responsive to the CINCs. This would give it the ability to reach across the services and be directly in tune to warfighter needs through the CINCs. Gen Rosenberg stated that the Army battle labs get their topcover by being sponsored by chief of staff of the Army. He suggested labs report to the Air Combat Command Commander, as he is directly tied to a warfighting CINC.[10] Along similar lines of thought, ADM Owens stated, "Keep information inside the council of four stars…they are much more open to innovation if the experimentation is not continually scrutinized. During my visits with the CINCs, I would have four star-only meetings…I found the generals became radically innovative and agreeable to change."[11]

Finally, Mr. Gilligan cautioned that battle labs could become hobby shops where senior leadership will see the latest technology and want it immediately. The result is changing schedules, funding, and possibly contracts. Often interoperability and compliance with current systems and architecture are also at risk. He insisted AF/XOC (Directorate of Command and Control) interaction with the C4 community is mandatory to provide consistent direction.[12]

Infrastructure. Infrastructure involves communications, systems, and a functional layout that best leverages the people and capabilities of the individual nodes. Locations such as the 505th Command and Control Evaluation Group (505CCEG) at Hurlburt AFB, where most Blue Flag exercises are planned and conducted, would have a large testbed corresponding to its mission and resources. Other locations, like the Vicenza CAOC, could use their operational configuration. Gen Pearson described a distributed network where operations, development, and research battle labs each contributed their expertise.[13]

Process

> *Unless there is a forcing function to field capability, they (the battle labs) can become a hobby shop.*
>
> —Gen Redden

The final and most difficult element is developing an operating process. The SAB *Vision of Aerospace Command and Control For the 21st Century* recommended a spiral C2 development process which fosters competition and innovations, technology push and requirements pull, and partnership with warfighters, developers, and industry. They suggested streamlining the requirements/funding process by consolidating C2 mission need statements and budgets and developing methods and tools (a development engine) to evaluate new capability. The process must rapidly select technology, field common C2 across the Air Force, and continually evaluate doctrine and TTP.[14]

While interviewees were in agreement with various components of the SAB recommendations, none tied together the entire model of technology, doctrine, and acquisition. Their comments have been divided into the four categories of boards, the spiral model, requirements, and other.

Boards. Boards are review groups that oversee the operations of the battle lab. Warfighting members must represent the operational community with a single voice on what is needed in the field. They must be ready to re-prioritize their requirements if battle lab experiments are approved and accepted. Developers must fully understand the operational needs, and given the warfighter approval, alter program development and funding plans. While all of the options presented for a new process involve boards, the following two options offer possible solutions. Gen Pearson recommends consolidating funds in major mission areas and providing that money to Special Program Offices (SPOs). The SPOs would search for promising technologies and concepts. If initial evaluations were successful, the SPOs would present a recommendation to an oversight board for approval to adjust requirements and funding. The board would be composed of major command and Pentagon staffs and chaired by ESC/CC. Its purpose would be to involve warfighters in the development process, minimize hobby shopping, and allow for rapid program modifications.[15]

An AFBL planning and execution process briefing suggested that an organization within Air Combat Command would convene an action group to review proposals. The results would be forwarded to a C2 General Officer Steering Group (GOSG). If the GOSG selects to proceed with project evaluation, it would direct the 505CCEG to coordinate and execute it. Once the project is complete, the 505CCEG would forward results to C2 GOSG. The GOSG would determine whether to fund and field, incorporate into ongoing programs, conduct further study, or drop the proposal.[16]

Spiral Model. The spiral model concept incrementally develops, tests, and fields technology. As capability is released to the warfighter and the requirements become better defined, additional capability is developed and released. By taking the development in small chunks, programs are more easily adaptable to changes in requirements, funding, and technology, while the warfighter gets capability to the field faster. Mr. Money believes the spiral model will get the acquisition cycle inside the technical cycle. It starts with the 80% solution, identifies and matches promising technology with requirements, tests it early, and gets warfighter feedback.[17]

Requirements. While the spiral model may overcome immature or incomplete requirements, they are still developed in a constrained forum. In the case of C2, operators need a place to look at the entire spectrum of capabilities, from systems in work to those already fielded. Seen as a whole, requirements can then be effectively evaluated and developed. Gen Franklin offered the following example: "Let's say we need to invest $1 billion next year. Lay out an operational configuration in the battle lab of existing and developing systems and evaluate them against today's doctrine. The results would give a new perspective on what is needed because now you see it all working together rather than in pieces. New systems would drop out due to redundancies or better alternatives, and holes would become apparent."[18] Mr. Henderson added that any changes to systems, requirements, or operations must comply with the Global Command and Control System (GCCS). The battle lab is ideal for validating compliance.[19]

Other. Currently, individual subsystems are developed to support a function, such as targeting for an AOC. This single function mentality creates interoperability challenges with other sub-systems and functions and only allows incremental improvements. While there will always be a need to develop individual systems to support critical operational needs, there should be a periodic evaluation and possible reinvention of operations as a whole. ADM Owens suggests assembling a team to experiment with new organizations, doctrine, and concepts.[20] Their mission could be taking the best pieces of industry, laboratories, product centers, and major commands, and putting together an entirely new form of operations center. The new configuration would be tested every year at a future flag exercise. After each yearly iteration it would be modified, thrown out, or improved, and in the fifth year it would be fielded. Why five years? The five year period allows for more continuity and robustness in the operational and technical design, is more economical than revamping operations annually, and provides ample time for budgeting. It also allows test, logistics, and training tails to keep pace and does not overwhelm warfighters with continual change. The concept is similar to aspects of the JFACC After Next program. However, it would draw on integrated Air Force talent and leadership, would be an ongoing experiment within the R&D process, and would not cost $100 million a copy!

Obstacles

> *Most revolutionary ideas will be opposed by a majority of decision makers.*
>
> —*New World Vistas Air and Space Power for the 21st Century*

Before concluding, a comment must be made about obstacles to implementation. The most prevalent one is a lack of understanding, leading to fear and oversimplification. By failing to comprehend the issues, concerns, requirements, and missions of each of the players, enormous mistrust has developed. The result is excessive oversight, criticism, and paranoia about roles and missions of individual organizations. Consequently, players are kept separate, leadership is timid, stovepiped systems are developed, and the acquisition and testing process becomes slow and tedious. Fear of failure not only prevents a Numbered Air Force from experimenting with a new technology or concepts in an exercise, but also creates animosity and mistrust between different R&D and acquisition entities.

The second nemesis is oversimplification of the mission and operations of each organization. Warfighters feel they can conduct development better than developers. Developers believe doctrine and training can be accomplished at R&D facilities. Many believe that COTS can solve all the operational woes and new technologies can be freely inserted into the existing infrastructure, regardless of architecture and standards. They are also under the misconception that by pouring money into a facility they can create an operational or technical brain trust. These thoughts cannot be farther from the truth. In today's environment the Air Force cannot afford egos, paranoia, or ignorance. It must take advantage of available assets and expertise and leverage them to produce the most effective configuration for the AFBL. The AFBL is intended to break down the barriers by encouraging communication and cooperation between its members.

Notes

[1]Joint Chiefs of Staff, Director of Command, Control, Communications, and Computers/Director, Defense Research and Engineering. *Advanced Battlespace Information System (ABIS),* Task Force Report, Major Results, Volume II: May 96, 5-2.

[2]Lt Gen Joseph J. Redden, Air University, Maxwell AFB, AL, interviewed by author, 26 Nov 96.

[3]Lt Gen (Ret) Charles E. Franklin, Sanders Co., interviewed by author, 15 Nov 96.

[4]ADM (Ret) William A. Owens, SAIC, interviewed by author, 4 Nov 96.

[5]Redden.

[6]Brig Gen David A. Nagy, Secretary of the Air Force for Information Dominance, interviewed by author, 26 Nov 96.

[7]Mr. Robert Nesbit, MITRE Corp., interviewed by author, 25 Nov 96.

[8]Brig Gen (Sel) Wilbert D. Pearson, Electronic Systems Center, Hanscom AFB, MA, interviewed by author, 24 Nov 96.

[9]Rosenberg.

[10]Rosenberg.

[11]Owens.

[12]Gilligan.

Notes

[13]Pearson.

[14]Air Force Scientific Advisory Board, *C4I Vision of Aerospace Command and Control For the 21st Century* 96, Summer 1996, 2-12.

[15]Pearson.

[16]Minutes of Air Force Battle Lab Action Group Meeting, 1-3 Oct 1996.

[17]Money.

[18]Franklin.

[19]Mr. James W. Henderson, ASEC, interviewed by author, 8 Nov 96.

[20]Owens.

Chapter 5

Recommendations and Conclusion

The final chapter will attempt to synthesize thoughts of interviewees, literature, and personal experience to recommend a course of action. Recommendations are organized under their corresponding critical elements and summarized in Table 1.

Table 1. Recommendations

Critical Elements	***Recommendation***	***Justification***
Manning	-Warfighters, Developers Industry, et. al.	-Without a unified team, new stovepipes would be created and synergy lost.
Location	-Single command and control battle lab core with distributed centers of expertise	-Takes advantage of existing facilities, expertise, and distributed comm. Single battle lab reduces tendency for stovepipes and increases cooperation among nodes.
Operations		
- Mission	-Dictated by node expertise. -Missions organized around *Joint Vision 2010 CONOPS*	-Nodes contribute their area of expertise. -*Joint Vision* focuses the AFBL on what it brings to the joint fight and forms the foundation for cooperation
- Organization	-Nodes organize around their abilities. -AFBL should report to Air Force vice chief of staff	-Leverages node expertise and facilitates innovation -Vice chief provides overall topcover, encourages cooperation, and supports his efforts in JROC & guiding Air Force
- Infrastructure	-Dictated by node resources -Provide limited O&M funds and network	-Nodes should leverage capabilities, but some funds and connectivity are required for experimentation and continuity
Process	-Unify three processes leading to military capability	-To be effective, the AFBL must rapidly mesh development, application and integration processes.

Critical Elements

Manning

One of the few areas completely agreed upon by each source was the contribution made by all players. While the players can contribute innovative ideas in technology and TTP, each has a unique area of expertise. Warfighters possess operational experience and knowledge, laboratories and industry bring leading edge technology and ideas, and product centers provide systems, architecture, and acquisition expertise. Isolating one group, or a set of players, would lead to the type of development in technology and TTP that we are now experiencing—inefficient and ineffective stovepipes. An effective lab breaks down barriers, rather than creating new ones.

Location

The answer is simple—everywhere. The Internet's success is derived from providing an enormous amount of information and interaction in a timely, user-friendly format to everyone. How does it do this? It allows participants to operate from their centers of expertise, whether these be homes, offices, or the field. During Base Realignment and Closure (BRAC), there was an attempt to move R&D centers closer to their warfighting counterparts. While this goal was admirable, it was determined centers of expertise only thrive in the environment that created and sustains them. A brain trust such as Silicon Valley or the corridor around Boston cannot be artificially created. Equally true, an operational trust will only exist where the warfighting disciplines reside.

Secondly, there is a real danger new stovepipes would be created by limiting the Air Force battle labs to six. The current AFBL proposal is a mix of concepts of operations

(Air Expeditionary Force and Force Projection), a sub-set of core competencies (Space Warfare, Information Warfare, and Battle Management), and a specific platform (Unmanned Aerial Vehicles). The organization and integrated operations of this conglomeration are destined for problems. The bottom line is there should be a single command and control battle lab, with continually changing nodes.

The essence of Air Force operations is centralized control and decentralized execution. A single lab would ensure interoperability, integration, and unity of effort. That does not mean it would be closely controlling the other nodes. Instead, it would allow the nodes to interoperate among themselves, aid in facilitating cooperation, and be the final operations check prior to fielding. The battle lab network would not be a location but a focus. When a technology or concept is new, the focus may be on a laboratory or industry node. As the experiment develops and matures it may shift to a product center, move to an exercise, or go directly to a field integration site. There should be hundreds of these cooperative experiments ongoing at once.

Operations

Mission. To give some structure and oversight into the process, the C2 AFBL divisions should be broken into their corresponding joint counterpart, i.e., precision engagement, focused logistics, dominant maneuver, and full dimensional protection. The Air Force core competencies and missions are easily rolled into these. This grouping would facilitate cooperation between the services and provide a more joint perspective for operations and for justifying funding of Air Force programs.

Organization. While each node would determine its own structure, organizations should be flat to ensure a free flow of ideas. Bright young talent should be rotated through to bring in fresh ideas, yet maintain currency within their area of expertise. Finally, the team needs ample topcover, preferably reporting directly to the location's commander.

As for the C2 AFBL, it too needs topcover and empowerment. To maximize visibility and minimize constraints, the AFBL should report directly to the Air Force vice chief of staff. While interviewees did not specifically recommend the vice chief, this recommendation represents a compromise which addresses their concerns. The association would allow the AFBL to reach across major commands, connecting it to the joint/CINC world through the JROC. The vice chief would benefit by having better insight into Air Force technology and doctrine development and would have a means to evaluate JROC proposals. Each month the AFBL division chiefs would brief the vice chief on their major projects. While the vice chief guides the strategic direction, AF/XOC could provide operational oversight. They could ensure a constant flow of information throughout the various disciplines, resolve major discrepancies between nodes, and could plan for, protect, and distribute battle lab funds. Due to their JTF/JFACC training mission, the 505CCEG should be the tactical lead. They should track individual experiments and metrics, facilitate coordination between nodes through a battle lab node's board, operate the communications center, and be the interface to the Joint Battle Center and related joint activities.

Infrastructure. Organizations are often hesitant to take advantage of facilities such as the Joint Interoperability Test Command or services provided by the Defense Information Service Agency because of their fee for service nature. Innovation will only flourish if the barriers are removed. Individual nodes on the AFBL should not have to pay for common infrastructure. An Air Force-wide T1 (data flow rate) leading edge services (LES) communications network must be provided for communications and simulations. The network should be expandable to the faster T3 data flow rate when experimentation dictates. Each node also needs access to common networks such as the Secret Switched Digital Network (SIPRNET), the Non-Secret Switched Digital Network (NIPRNET), and the Joint Worldwide Intelligence Communications System (JWICS). The Air Force cannot be a technology and operations leader without high data rate communications between facilities. A network operations and scheduling center should be created immediately to manage the communications of the AFBL. Finally, nodes should be provided with a modest amount of operations and maintenance funding. While they should be able to reallocate and/or leverage their assets and expertise, some degree of additional funding is required for specialized equipment, staffing, facilities, and exploratory experimentation.

Process

The most difficult challenge for the AFBL will be how to integrate into the current system of requirements, development, acquisition, test, support, training, and operations. Not only is the battle lab portion of the process new, but acquisition and doctrine are experiencing a rebirth. Meshing the processes of development, application, and integration is imperative. The elements in these processes are shown in figure 1.

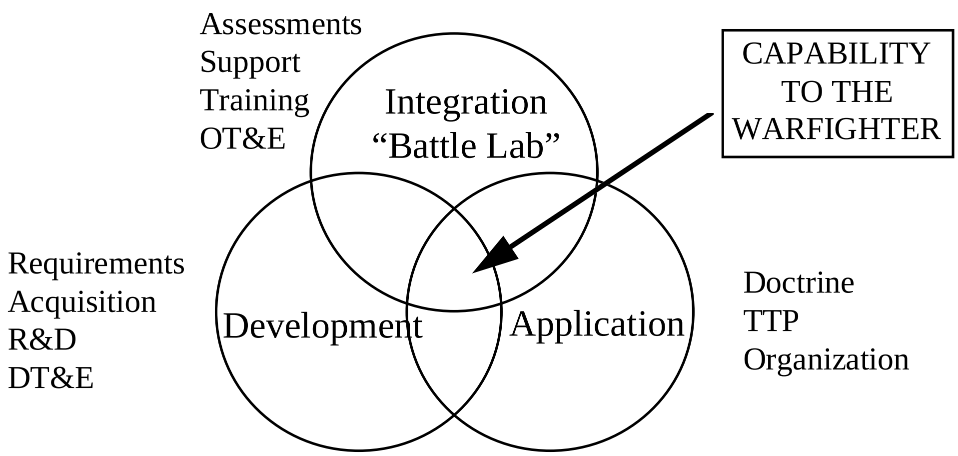

Figure 1. Capability Process

The spiral acquisition process, combined with loosening regulations and a project approval board, appears to be an effective way to rapidly identify, fund, develop, and evaluate projects. It will become the core of the development process. As the new doctrine center stands up, it will become the heart of the applications process. One of its first tasks should be to determine how it would integrate with the acquisition and integration groups. The final process, integration, will be performed by the AFBL.

The AFBL would be fed experiments from the other two processes, while reciprocating with evaluations and additional ideas and technologies. Incentives for the AFBL nodes would come from approval and funding of projects. The approval flow might operate as follows: 1) a technology or concept is identified; 2) a team of affected node experts are “virtually” assembled for an initial evaluation (paper or breadboard); 3) a proposal involving cost, participants, timeline, and metrics is prepared; 4) the proposal is sent to the appropriate group for approval (acquisition board, doctrine board, or vice chief); 5) the experiment is conducted and results sent to the approval authority; 6) the technology or concept is incorporated into ongoing programs, sent back to the AFBL for final wring-out and test, or fielded immediately.

Because of their current integration activities and complimentary C2 assets and missions, a test configuration at the CUBE and 505CCEG should be initiated. These units should receive immediate funding and direction to begin the development of a formal battle lab process. Metrics should be proposed and briefings to the vice chief initiated. Developmental and operational testers may play a key role in aiding the development of metrics that focus on the big picture of developing and delivering capability. At the same time, AFBL nodes across the Air Force should be established and their connection to the AFBL hub completed.

One of the first AFBL-wide experiments must be the validation of requirements against the C2 infrastructure, as recommended by Gen Franklin. This not only is an excellent vehicle to identify strengths and weakness of current doctrine and systems development but is also an excellent integration exercise for the AFBL. It should also force GCCS compliance and the development of a global C2 architecture and CONOPS. While the first few yearly iterations of this “requirements experiment” might be miserable failures, they would quickly build into a detailed plan which would be adaptable for the DOD.

Finally, an autonomous team should be formed to assess and redefine air and space operations and determine how to put *Global Engagement* into the field. This team should be unencumbered by systems development and parochial interests and be provided ample autonomy, empowerment, and funding to draw necessary resources. Led by doctrine innovators, the joint team of warfighters, developers, and industry should report directly to the vice chief of staff. The battle lab process would have to be one of trial and error, but the bottom line is to stop speculating and start trying!

Conclusion

The Department of Defense is at a crossroads never before experienced. Geopolitical upheaval, new missions, declining defense budget, and rapidly changing technology are offering new challenges and opportunities. Information has moved from a tantamount position on the battlefield to a paramount one. The ability of a nation and its military to adapt to technology and use and protect information will dictate its future on the global stage. The C2 AFBL provides the ability to make that rapid adaptation.

A battle lab breaks down the serial development process and creates a parallel effort where technology, doctrine, and TTP are created in unison. By bringing together the brightest people from across the warfighter, developer, and industry communities, the same synergistic effect that produced the Internet could be harnessed to rapidly create military capability. By its very nature, the Air Force's mission of Global Reach Global Power makes it well suited to lead information superiority for the Department of Defense. An Air Force Command and Control Battle Lab would assure information superiority and US dominance on future battlefields.

> *The world is moving so fast these days that the man who says it can't be done is generally interrupted by someone doing it.*
>
> —Elbert Hubbard

Glossary

ABIS	Advanced Battlespace Information System
ACTD	Advanced Capability Technology Demonstration
ADM	Admiral
AFBL	Air Force Battle Lab
AOC	Air Operations Center
ATO	Air Task Order
BRAC	Base Realignment and Closure
C2	Command and Control
C3I	Command, Control, Communications and Intelligence
C4I	Command, Control, Communications, Computers and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAOC	Combined Air Operations Center
CINC	Commander In Chief
CONOPS	Concept of Operations
COTS	Commercial Off-The-Shelf
CRDA	Cooperative Research and Development Agreement
CUBE	Command and Control Unified Battlespace Environment
DISA	Defense Information Service Agency
DOD	Department of Defense
FF	Fort Franklin
GBS	Global Broadcast System
GOSG	General Officer Steering Group
GOTS	Government Off-The-Shelf
ISDN	Integrated Switched Digital Network
JBS	Joint Broadcast Service
JCS	Joint Chiefs of Staff
JFACC	Joint Force Air Component Commander
JITC	Joint Interoperability Test Command
JROC	Joint Requirements Oversight Council
JWICS	Joint Worldwide Intelligence Communications System

JWID	Joint Warrior Interoperability Demonstration
LES	Leading Edge Service
MAJCOM	Major Commands
NAF	Numbered Air Force
NIPRNET	Non-Secret Switched Digital Network
O&M	Operations and Maintenance
PMD	Program Management Directive
R&D	Research and Development
SAB	Scientific Advisory Board
SIPRNET	Secret Switched Digital Network
SPO	Special Program Office
TBMCS	Theater Battle Management Core Systems
TTP	Tactics, Techniques, and Procedures
VCJCS	Vice Chairman, Joint Chiefs of Staff
WOC	Wing Operations Center
AF/XOC	Directorate of Command and Control

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